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Michael Zanko

University of Wollongong, mzanko@uow.edu.au

Jan Turbill

University of Wollongong, jturbill@uow.edu.au

Christopher Sykes

University of Wollongong, csykes@uow.edu.au

Belinda Gibbons

University of Wollongong, bgibbons@uow.edu.au

Lee Moerman

University of Wollongong, leem@uow.edu.au

See next page for additional authors

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Building a matrix in the students' mind through embedding cross-disciplinarity in innovative capstone courses

Abstract

Universities are increasingly looking to round off undergraduate business degrees with a capstone course that provides students with learning experiences that synthesise prior knowledge, skills and abilities acquired throughout their degree and that leads them to look forward to the transition to the world of employment and professional careers. Capstone courses are also widely employed by universities as an efficient and effective basis for the justified assurance of overall degree learning goals/outcomes often for external professional, international or governmental accreditation purposes. In this paper, we take a closer look at these increasingly important capstone courses as part of a multi-university project funded by the Australian Learning and Teaching Council on 'Good Practice in Capstone Courses in Undergraduate Business Degrees', which is aimed at developing a better understanding of the purpose of capstones and the best approaches to course design, learning activities and assessment. First, we define a capstone course. Next, we look at the two dominant types of capstone reported in the relatively scant research literature: disciplinary magnets and cross-disciplinary mountaintops. We report on their usage based on an audit of all Australian university websites. We then focus on a more detailed examination of the cross-disciplinary mountaintop capstone since it is this type that brings together students majoring in a range of disciplines to work together in cross-disciplinary teams on a set of cross-disciplinary problems that more closely represents the reality of work and industry. The intention embedded in such a mountaintop is to provide cross-disciplinary learning, in effect building an integrative, cross-disciplinary matrix in the student's mind (after Bartlett and Ghoshal, 1989), one which enables the student to engage simultaneously with a variety of disciplinary perspectives, processes and possibilities as experienced in the 'real' world. Such mountaintops require careful and considered cross-functional 'matrix' conceptualization, design, development, implementation and evaluation that involve an interdisciplinary teaching team. In this paper we provide a detailed case analysis of the innovation processes involved in the creation and operation of such a mountaintop capstone that employs a highly innovative, locally produced business simulation that embraces triple bottom-line criteria and the United Nations Global Compact Principles that embody the key concepts human rights, labour standards, the environment and anti-corruption. The advantages as well the challenges associated with this initiative are discussed. Suggestions for future capstone course practice from research into cross-functional teams, matrix organizations and organizational politics associated with product and process innovation are outlined.

Keywords

mind, students, embedding, building, courses, matrix, cross, disciplinarity, innovative, capstone

Disciplines

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Authors

Michael Zanko, Jan Turbill, Christopher Sykes, Belinda Gibbons, Lee Moerman, and Trevor Spedding

BUILDING A MATRIX IN THE STUDENT'S MIND THROUGH EMBEDDING CROSS-DISCIPLINARITY IN INNOVATIVE CAPSTONE COURSES

**Michael Zanko¹, Jan Turbill², Chris Sykes³, Belinda Gibbons⁴,
Lee Moerman⁵, Trevor Spedding⁶**

¹Faculty of Commerce, University of Wollongong, AUSTRALIA

²Faculty of Commerce, University of Wollongong, AUSTRALIA

³School of Management and Marketing, University of Wollongong, AUSTRALIA

⁴Faculty of Commerce, University of Wollongong, AUSTRALIA

⁵School of Accounting and Finance, University of Wollongong, AUSTRALIA

⁶Faculty of Commerce, University of Wollongong, AUSTRALIA

mzanko@uow.edu.au

jturbill@uow.edu.au

csykes@uow.edu.au

bgibbons@uow.edu.au

leem@uow.edu.au

spedding@uow.edu.au

Abstract

Universities are increasingly looking to round off undergraduate business degrees with a capstone course that provides students with learning experiences that synthesise prior knowledge, skills and abilities acquired throughout their degree and that leads them to look forward to the transition to the world of employment and professional careers. We take a closer look at these increasingly important courses as part of a multi-university project funded by the Australian Learning and Teaching Council. First, we define a capstone course. Next, we look at the two dominant types of capstone: disciplinary magnets and cross-disciplinary mountaintops. We report on their usage based on an audit of all Australian university websites. We then focus on a more detailed examination of the cross-disciplinary mountaintop capstone. The intention embedded in such a mountaintop is to provide cross-disciplinary learning which enables the student to engage simultaneously with a variety of disciplinary perspectives, processes and possibilities as experienced in the 'real' world. In this paper we provide a case analysis of the innovation processes involved in the creation and operation of such a mountaintop capstone that employs an innovative business simulation in the Faculty of Commerce at the University of Wollongong in Australia. The advantages as well the challenges associated with this initiative are discussed.

Keywords: capstone course, mountaintop, magnet, simulation, cross-disciplinary, matrix

1 INTRODUCTION

With increasingly complex, globalized and competitive markets, accelerating technological change and growing expectations of ethical behaviour, it is now widely accepted that organizations have to compete more in terms of the time-to-market and innovativeness of their products in a socially responsible and sustainable manner. Innovation is considered essential for successful business performance in response to turbulent task and institutional environments (Andriopoulos and Dawson, 2009; Dougherty and Hardy 1996; Mavondo, Chimhanzi and Stewart 2004). This has reinforced the interest in both effective product and organizational process innovation (Fagerberg, Mowery and Nelson 2005). Organizational innovation initiatives have included a range of structural approaches such as concurrent engineering, cross-functional teams and matrix organization.

A challenge for higher education institutions such as universities is to produce students who are equipped to be sustainably innovative and socially responsible in their future careers and lives. This involves providing them with knowledge and learning experiences to build the relevant know-how and skill-set. Capstone courses are increasingly being used by universities, particularly business schools and faculties, to assure the acquisition of such generic graduate capabilities. Universities are increasingly seeking to round off undergraduate business degrees with a capstone course, one that provides students with learning experiences that synthesise prior knowledge, skills and abilities acquired throughout their degree and that leads them to look forward to the transition to the world of employment and professional careers. Capstone courses are also widely employed by universities as an efficient and effective basis for the justified assurance of overall degree learning goals/outcomes often for external professional, international or governmental accreditation purposes.

In this paper, we take a closer look at these increasingly important capstone courses as part of a multi-university project funded by the Australian Learning and Teaching Council on '*Capstone Courses in Undergraduate Business Degrees: Better Course Design, Better Learning Activities, Better Assessment*'. First, we define a capstone course. Next, we look at the two dominant types of capstone reported in the relatively scant research literature: magnets and mountaintops. We report on their usage based on an audit of all Australian university websites. We then focus on a more detailed examination of the cross-disciplinary mountaintop capstone since it is this type that brings together students majoring in a range of disciplines to work together in cross-disciplinary teams on a set of cross-disciplinary problems that more closely represent the reality of work and industry.

The intention embedded in such a mountaintop is to provide cross-disciplinary learning, in effect building an integrative, cross-disciplinary matrix in the student's mind, one which enables the student to engage simultaneously with a variety of disciplinary perspectives, processes and possibilities as experienced in the 'real' world. This notion of creating a matrix in the mind is based on Bartlett and Ghoshal's (1989) seminal research into the management challenges facing multinational enterprises in fast changing, complex and uncertain environments. In-depth case studies in world leading multinationals revealed the need to embrace and then go beyond structural, functional, locational and policy/procedural arrangements. As they observed: 'One senior manager described the organizational task facing his company in a provocative way: "It is not so much to change the structure into a matrix as it is to create a matrix in the minds of our managers". The more individuals can resolve complex and potentially contradictory issues, the less the organizational system has to cope with them.' (Bartlett and Ghoshal, 1989: 195). The development of such individuals was central to creating the matrix in the mind. Effective mountaintop capstone courses are developmental experiences that also seek to create a matrix in the mind, an intersection between disciplinary, functional silos of expertise.

Mountaintop capstones require careful and considered cross-functional 'matrix' conceptualization, design, development, implementation and evaluation that involve an interdisciplinary teaching team. In this paper we provide a detailed case analysis of the innovation processes involved in the creation and operation of such a mountaintop capstone that employs a highly innovative, locally produced business simulation that embraces triple bottom-line criteria and the United Nations Global Compact Principles that embody the key concepts human rights, labour standards, the environment and anti-corruption. The advantages as well the challenges associated with this initiative are discussed. Suggestions for future capstone course practice from research into cross-functional teams, matrix organizations and organizational politics associated with product and process innovation are outlined.

2 CAPSTONE COURSES

The discussion in this section draws largely on work carried out for the Australian Learning and Teaching Council funded project '*Capstone Courses in Undergraduate Business Degrees: Better Course Design, Better Learning Activities, Better Assessment*', in which the first two authors are investigators.

2.1 Definition

According to Holdsworth, Watty and Davies (2009: 2) 'The term 'capstone' is widely used to describe a course or experience that provides opportunities for a student to apply the knowledge gained throughout their undergraduate degree. This involves integrating graduate capabilities and employability skills, and occurs usually in the final year of an undergraduate degree.'

Capstone subjects look backwards and forwards. Backwards, in that they bring together the knowledge and experiences students have acquired during their studies by providing an opportunity to reflect on the program as a whole, and by allowing them to make connections between the subjects they have studied. They look forward by providing a vehicle for the early development of professional identity as part of the transition to employment (Lizzio and Wilson, 2004), and for students' self-efficacy as fledgling practitioners (Dunlap, 2005). Van Acker and Bailey (2011: 69) contend that capstones may be also used to confirm and assure that students have mastered what are variously referred to as 'employability', 'graduate' or 'generic' skills (capabilities/attributes/qualities).

2.2 Types and Usage

Rowles, Koch, Hundley and Hamilton (2004: 13) have identified three main types of capstone course:

- mountaintop capstones—these are interdisciplinary in that they that cross majors and bring together diverse groups of students (and potentially staff)
- magnet capstones—these are discipline (or major) specific, such as finance, accountancy, marketing, management etc.
- 'mandate' capstones—mandated by an external constituency, such as a practitioner or registration body.

An audit of capstone subjects (in January 2011) via a search of Australian university websites showed thirty-four of 39 business schools (87 per cent) offered at least one course in their undergraduate program that is described as a capstone and is a core requirement. Magnet capstones were the most common pattern of capstone subjects, applicable to just over half Australian business schools, is the provision of in *some* majors, but not in all. Only three universities had a comprehensive suite of 'magnet' capstones in *every* business major. Mountaintops were less common. Eleven universities (28 per cent) offered mountaintops. Six of these offered also magnets in *some* majors. No mandated capstones were found in undergraduate business degrees.

Based on the project research, the defining features of undergraduate business capstone courses were found in their capacity to allow students to:

Integrate—to bring together what they have learned throughout their degree program, to make connections between different subjects and to see 'how it all fits together'.

Consolidate—to consolidate the key skills that are essential to success in their professional lives, including:

the ability to collaborate and work effectively in a team;

the capacity to communicate effectively, both orally and in writing; and

the ability to solve problems by applying theory and reconciling differing perspectives.

Apply—to apply what they know by exploring an issue or solving an authentic, 'real world' problem, in a way that simulates professional practice.

Reflect—to reflect on their actions and experiences, to equip them to be reflective practitioners and citizens.

Develop—to begin to develop a professional identity and to develop confidence in their professional capacity.'

3 EMBEDDING CROSS-DISCIPLINARITY IN A CAPSTONE CASE STUDY

In this case study we describe and discuss the multi-layered, cross-disciplinary approach we adopted in the conceptualization, development and implementation of an innovative mountaintop capstone subject for the Bachelor of Commerce degree at the University of Wollongong. The University of Wollongong is situated in New South Wales, Australia about 80km south of Sydney. Ranked in the top 2% of research universities in the world (according to QS World University Rankings), it has a student population of almost 29,000 (in 2011) of which more than 7000 students are enrolled in Commerce degrees at 6 onshore and 4 offshore campuses. The University has a strong national reputation in learning and teaching. The Bachelor of Commerce is the Faculty's flagship undergraduate program. It is the largest degree by far offered by the University. It is a 3 year fulltime degree where students are

required to undertake a common foundation year made up of key introductory disciplinary courses in accounting, finance, economics, management and marketing; plus a course called the Principles of Responsible Commerce that introduces students to the origins of and developments in contemporary systems of commerce, ethical and social responsibility in commerce (areas addressed include the environment, globalization, technology, anti-corruption, labour and human rights). In their second and third years, Bachelor of Commerce students are required to complete at least one major from a choice of 14 (such as accountancy, finance, marketing, public relations, international business, human resource management) plus a choice of electives, minors or an additional major. In their final year, all undergraduate students are required to complete a capstone course which is open to students from all majors. In this sense it is a mountaintop capstone unlike some of the majors that have their disciplinary magnet capstones (such as Strategic Management, Strategic Marketing, and Public Relations Campaigns). Several hundred students complete the mountaintop capstone course each year. Students are able to undertake one of 2 capstones on offer: *Simulation of a Socially Innovative Enterprise* or *Applied Business Research for Social Innovation*. The Simulation course was designed to be the one for most students to complete and at multiple locations; the Applied Business Research course was intended for a much smaller cohort (30 or so) and at a single location – the main campus. The focus in this paper and for the remainder of this case study is on the Simulation course.

3.1 Origins

In 2008/9 the Bachelor of Commerce degree underwent a thorough internal and external review for a number of reasons, including: to satisfy the University's 5 year curriculum review cycle, to ensure that the degree aligned with the recently formulated Faculty purpose/mission ('to inspire socially innovative commerce through research and education'), to integrate the newly formulated five Faculty graduate qualities into all courses and degrees, and to align with external international accreditation standards. The review process was overseen by a Steering Committee led by the Associate Dean (Academic Programs). Given the size of the degree in terms of student enrolments (and income from both domestic and international onshore and offshore students) this review was considered of strategic significance not only to the Faculty of Commerce but to the University. Curriculum changes received close scrutiny from many 'stakeholders' within the Faculty, the University as a whole (including senior executives) and from industry advisors. The review process and proposed changes were politically sensitive.

3.2 Cross-Disciplinary Review Steering Committee

The Bachelor of Commerce Review Steering Committee comprised the Associate Dean (Academic Programs), three Heads of the Schools in the Faculty, the Associate Dean (International), a Teaching and Learning consultant, the Dean of Commerce (ex-officio), the Faculty Executive Manager and a student representative. This cross-disciplinary committee representing the five major disciplines (Accountancy, Finance, Economics, Management and Marketing) and key executive interests constituted what might be considered an integrated and empowered team. It was integrated to the extent that it incorporated all the different disciplines involved in the curriculum review process and combined them in addressing problems and issues at each identified stage. It was empowered to the extent that it had the requisite skills, information, tools, and authority to make the decisions necessary for the curriculum review process to proceed in an effective and efficient manner. In this sense, the Steering Group was what Wheelwright and Clark (1993) refer to as a heavyweight team, one 'marked by effective, forceful leadership, strong problem-solving skills, and the ability to integrate across functions' (Zanko et al, 1998: 129). Over the numerous meetings held over several months, there was much contestation and turf wrangles over a range of curriculum issues mainly concerning the introductory disciplinary courses. In contrast, there was broad agreement and consensus about the need for a new suite of cross-disciplinary capstone courses to replace the then existing final year integrating courses which, it was considered, did not integrate students' prior learning nor prepare them for their futures very effectively. Further, it was agreed that these capstones should provide a clear and measurable line of sight with the Faculty purpose/mission and assure achievement of the Faculty's graduate qualities. It was also resolved that these capstone courses would be designed, developed and delivered by cross-disciplinary teams with representatives from each of the three schools. The Faculty has remained true to this approach since 2008.

3.3 Cross-Disciplinary Core Curriculum Subcommittee and Capstone Working Group

Late in 2008, and at the behest of the steering committee a Core Curriculum Subcommittee of the Commerce Faculty Education Committee (the major learning and teaching governance organ) was established to preside over the conceptual design development and delivery of all core Bachelor of Commerce courses including the new capstones. This committee, made up of even more disciplinary representatives than the Steering Committee (core subject coordinators representing 12 core subjects), oversaw a working party set up to create the new capstones. Led by the Head of the School of Management and Marketing (who also had expertise in building and running simulations), the working group, with its three disciplinary representatives, crafted course proposals for the capstones including the *Simulation of a Socially Innovative Enterprise*. Having explored the possibility of using off-the-shelf proprietary business simulations, it was found that there was not one that satisfied the need to integrate business learning experiences in a way that embraced and integrated concepts of social responsibility and social innovation. The proposal that was accepted and supported by the Faculty was to build and operate our own business enterprise simulation, one that is unique in business higher education.

3.4 Cross-Disciplinary Capstone Development Team and Subcommittee

In 2009, the Capstone working party became the Capstone Development Committee and worked with concept course proposals to convert, develop and implement them as part of the Bachelor of Commerce. Membership once again was made up of nominated subject coordinators from each of the three Schools (Accounting and Finance, Economics, and Management and Marketing) supported by a Teaching and Learning consultant. Over the two and a half year staged development phase, with fortnightly meetings subject content, lectures, tutorials and assessments were negotiated and agreed by the team members (noting the different disciplinary traditions). A range of issues also were addressed by the Committee such as timelines for roll-out in onshore and offshore locations, scheduling assessments, modularisation of lectures, use of groupwork self and peer assessment technology, tutor selection, engaging with the Schools in the development of the cross-disciplinary nature of the subject so as to minimise potential confusion, building capability through a larger shadow teaching team, administrative support, book production through a commercial publisher, undertaking scholarly reviews and marketing capstones to incoming students. Problems encountered by the Committee concerned workload allocation and the lack of decision-making scope. These were addressed through facilitated workload allocation by an associate Dean as well as the establishment of the Committee as an official subcommittee of the Faculty Education Committee. This latter initiative would provide this group with greater voice in the Faculty and also ensure the contributions of members were factored into their workloads. Throughout this period work on simulation development was being undertaken.

3.5 Cross-Disciplinary Capstone Course Structure, Content and Assessment and Delivery

Cross-disciplinarity was woven throughout the subject in terms of structure, content, assessment and delivery. The structure was cross-disciplinary primarily through the operation of the simulation (discussed below) together with the formation of multidisciplinary teams of students for playing the simulation. The teaching team is made up academic colleagues drawn from each of the three Schools. The objectives of the course are:

1. Demonstrate the capacity to problem solve and effectively work in multidisciplinary contexts.
2. Demonstrate a deep understanding of theoretical principles that underpin the complexities of commercial practice.
3. Apply a wide range of innovative commercial practices as they construct and are constructed by intercultural values and identities in societies.
4. Demonstrate and apply the principles and ethical underpinnings of corporate governance best practice in a globalised environment.
5. Demonstrate a knowledge of the dynamics of working both within a team and a system.
6. Demonstrate an understanding of the use of specified information and communication technologies.

Cross-disciplinary assessment is found through a comprehensive company operations reporting assignment made up an interim report, end of performance report, team meeting with board of directors (all team-based tasks) plus an individual reflective report to encourage integration of perspectives and cross-disciplinary learning *-building a matrix in the student's mind.*

With a prototype trialled in 2010, the Simulation Capstone course was delivered to full-size cohorts numbering some hundreds in 2012. Early indications are that students find the course to be very stimulating and engaging; they are making meaningful connections between theory and the world of practice.

3.5.1 Cross-Disciplinary Simulation

The Deputy Dean created the simulation design concept architecture in conjunction with one fulltime academic and one casual business information systems colleague. The academic colleague developed the simulation detail in consultation with the then Deputy (now Dean). The simulation is titled IDLE (Interactive Dynamic Learning Environment). It was developed following consultation and input from colleagues from the five main Faculty disciplines to ensure the range of factors and decisions reflected theoretical and applied practice. IDLE is a web based simulated business environment in which multidisciplinary teams compete across a performance matrix which includes profit, environmental impact, sustainability, social responsibility, quality of service and ethical performance. IDLE focuses specifically on broadening the understanding of the interrelationship between enterprise and society by anchoring Corporate Social Responsibility (CSR) and sustainability in the strategy and activities that arise during the running the business. Currently, IDLE provides students with the opportunity to run their own company, managing all the key functional areas of a firm (HRM, finance, marketing, operations, accounts) whilst considering the economic, environmental and social consequences of their decision-making. The simulation is integrative and holistic. It is modelled to reflect the real-world character of the globally competitive smart phone industry and structured so that the multidisciplinary impacts of their decisions are realised as they compete against companies run by other class members. Company operations are patterned after those of a smart phone company that produces its smart phones at its Australian plant rather than outsourcing production to contract manufacturers. Cause-effect relationships and revenue-cost-profit relationships are based on sound business and economic principles. All aspects of IDLE closely mirror the competitive functioning of the real-world smart phone market. The screenshot below shows the key performance indicators used in the simulation.

University of Wollongong [Main Menu](#) [Round Schedule](#) [Decisions](#) [Idle Participants Guide](#) [Scoreboard](#) [Logout](#) [Archive](#) [Support](#)

IDLE

Messages

Welcome to IDLE.

Week 7: This week you will be introduced to the simulation. Make sure you have read the company participants guide and have completed the online quiz by the end of week 8.

[Round Schedule](#)

Detailed Scoreboard 2012

Profit	-\$1,144,280
Productivity	5 %
Quality	5 %
Reputation	17 %
Green Rating	0 %

Leaderboard after round 1

Competition does not begin until week 9.

Last login details

[clear run count](#)

Creation Time	Run Description	View Run	Delete Run	Resume Run
12/09/10 at 2:28 PM		View Run Results	Delete	
12/08/10 at 2:23 PM		View Run Results	Delete	
12/02/10 at 2:37 PM		View Run Results	Delete	

Dynamic Learning Environment Main Menu Screen

4 ADVANTAGES AND CHALLENGES

The advantages derived from creating and implementing the innovative mountaintop capstone *Simulation of a Socially Innovative Enterprise* arise in student learning and faculty involvement. Students learn how to work in a cross-disciplinary team where 'represent' their discipline and at the same time learn about the perspectives, language and approaches of others in a complex, real world simulated setting. It prepares them for the kind of cross-disciplinary work environments they are likely to encounter in future careers. In this way it begins to develop their identity as a professional alongside other professionals (fellow students), and realise the unique knowledge and skills each type of practitioner brings to a team. It builds a cross-disciplinary matrix in their mind. For the academics involved, the outcomes are similar to those for students. Working on a simulation mountaintop capstone is a rare opportunity to collaborate with colleagues from different disciplines in teaching. From an organizational perspective, it helps build interdisciplinarity by beginning to break down the heavy siloed barriers that traditionally surround academic disciplines. This leads to the opportunity to create shared beliefs, understandings and languages by often loosely coupled academics that can lead to meaningful, valued and relevant learning for themselves and their students. It is a highly distinctive and balanced mountaintop capstone.

The design, development and delivery of this innovative, integrative, holistic cross-disciplinary capstone course has depended on strong ongoing support from the Dean and from numerous dedicated academic staff. The multiple layers of cross-disciplinary inputs and expertise over a number of years represent genuine and major commitment from the Faculty and a substantial investment to this final 'capping' experience. Curriculum innovation such as that described above is a complex and politically demanding process. Challenges have also included cross-disciplinary staffing allocation in a discipline-centric structure, where such decisions are typically made by disciplines where academics are typically based; this is currently brokered by an Associate Dean. Moving to consensus on content in a cross-disciplinary task environment is also a time-consuming process. The need to acquaint academic teachers and tutors with bespoke cross-disciplinary material also differs from a traditional discipline-centric approach.

5 CONCLUSION

Building and operating the cross-disciplinary mountaintop capstone *Simulation of a Socially Innovative Enterprise* is a major initiative. However, the ability to engage students in a learning environment that captures the complexities of the real world, and that allows them to draw upon and apply their acquired disciplinary know-how in their final year through the simulation means that they are likely to be better equipped to be ethical, socially, environmentally and, of course, commercially responsible in their occupational and professional worlds. This is a key commitment to our students.

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